

Geology 231 – March 17, 2011

Relative age dating techniques and recognition of basic field relations of igneous and sedimentary units

Today's exercise will involve the examination of a road cut at Beavertail Hill, about 25 miles east of Missoula along I-90. The main goals of this exercise are to:

1. provide you with experience identifying and recognizing different rock types in the field.
2. provide you with experience recognizing the geometry of different rock units in the field (sill vs. dike vs. sedimentary layer, etc.) and visualizing these geometries in three-dimensions
3. introduce you to a variety of relative dating techniques and apply them in the field

In our discussions today, we will focus on five main **relative dating techniques**:

- 1. principle of original horizontality:** sedimentary rocks are deposited in horizontal layers. Therefore, if sedimentary rocks are observed to be tilted, they must have been deformed.
- 2. principle of superposition:** the oldest rocks were deposited first and form the lowest layers in an undeformed sequence of sedimentary rocks. Younger and younger deposits were deposited on top of older units.
- 3. principle of cross-cutting relationships:** a geologic unit must first exist before something can happen to it. Features that cut across other features (e.g. unconformity, dike) are younger than the feature they cut across.
- 4. principle of included fragments:** geologic units must exist before pieces of them can break off and be incorporated into younger units. Therefore, the unit from which the pieces came is older than the unit which incorporated the broken pieces.
- 5. principle of faunal succession:** sequence of evolving fossils follows the principle of superposition. In an undisturbed sequence of rocks, the oldest fossils will be in the lowest layers; younger and younger fossils will be in higher and higher layers.

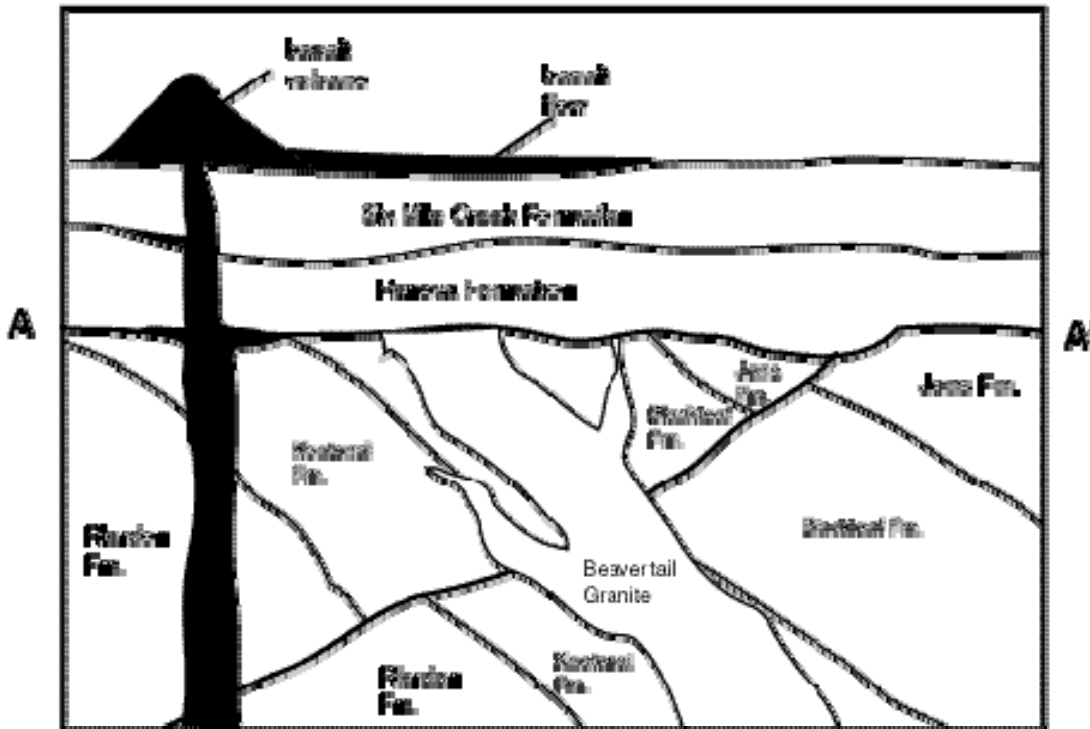
We will also discuss the concept of an **unconformity** – that is a surface in a sequence of sedimentary rocks which represents a period of non-deposition or erosion. Important to this discussion are the following concepts:

- 1. unconformable rocks units:** sedimentary rocks separated by an unconformity
- 2. conformable rocks units:** sedimentary rocks deposited one after another without any breaks in time or periods of erosion between them
- 3. angular unconformity:** earlier deposited sedimentary layers were deformed, tilted, and eroded before deposition of next layer of sedimentation. An angle is formed between the earlier formed beds and the later formed beds after the erosion.
- 4. non-conformity:** an unconformity in which sedimentary rocks rest upon uplifted and eroded igneous or metamorphic rocks.

Your assignments for this week (due at class time, Tuesday, March 23, 2011):

Part 1 (20 points total): Below is a hypothetical cross-section showing a number of different units and structures.

Look over the cross-section below and place each “event” into its relative order. Examples of “events” include: 1) deposition of a sedimentary layer; 2) tilting or folding of sedimentary or other layers; 3) faulting of layers; 4) intrusion by igneous units; and 5) formation of erosional unconformities.



Now answer the following questions:

- 1) What is the nature of the base-Renova contact? (i.e., surface A-A')? In other words, what kind of surface is this?
- 2) What sorts of igneous bodies (sill, dike, flow) does the basalt form? Label each different type on the edge of the diagram.
- 3) What kind of fault is shown cutting the sedimentary units (Rierdon through Jens Formations)? What is your evidence? Was this fault formed due to compression or extension?

Part 2 (30 points total): Beavertail Hill location: Carefully sketch an east-west cross-section through this hill, showing the four different rock units that we will discuss. Include with your sketch a 1-2 paragraph type-written discussion of 1) the units you saw, describing each briefly; and 2) the specific evidence you use to place the units into their relative order.

If you desire, you may hand in more than one sketch to show the features you used to place these units into their relative ordering of events, but I do want at least one “master” cross-section showing each of the units we discussed on the outcrop. Be sure that your sketch is neat and professional-looking and that you have answered each of the two written questions thoroughly. Also, a portion of your grade for this part of the assignment will be directed at assessing your writing skills, so don't be hasty with this part.